

We Claim:

- 1 1. A semiconductor device identification apparatus for reading an
2 identification pattern from the surface of a semiconductor device, the identification
3 pattern including a matrix of holes or elevations formed in the surface, comprising:
4 a source of radiation for irradiating the holes or elevations;
5 a sensor for detecting the radiation being reflected from the surface and the holes
6 or elevations;
7 a means for determining the distance of the sensor to the semiconductor device
8 surface;
9 at least one motor for moving the sensor in at least one distance level above the
10 surface;
11 a control unit for controlling the movement due to the at least one motor; and
12 an image processing unit, the image processing unit being designed to generate a
13 three-dimensional image of the surface with the matrix of the holes or elevations, the
14 image processing unit being connected to
15 a) the means for determining the distance for acquiring distance data, and
16 b) the control unit for acquiring positional data of the sensor.
- 1 2. The apparatus according to claim 1, wherein the radiation has a spot
2 diameter of less than the diameter of the holes or elevations.

1 3. The apparatus according to claim 2, wherein the source of radiation is a
2 laser.

1 4. The apparatus according to claim 1, wherein the sensor is a position
2 sensitive device receiving reflected light by a beam divider.

1 5. The apparatus according to claim 1, wherein the image processing unit
2 includes a pattern recognition means for identifying the identification pattern.

1 6. The apparatus according to claim 1, wherein the matrix of holes or
2 elevations represents a bar code on the semiconductor device.

1 7. The apparatus according to claim 2, wherein the laser spot diameter ranges
2 from 4 μm to 20 μm , the vertical measurement range of the laser is 300 μm , the vertical
3 height of at least one of the holes or elevations is more than 80 μm , the diameter of at
4 least one of the holes or elevations (is more than 80 μm .

1 8. The apparatus according to claim 1, further comprising:
2 a stage carrying the sensor;
3 at least one first guide rail, at which the stage is mounted being freely disposable
4 in a first direction;
5 at least one second guide rail, at which the first at least one guide rail is mounted
6 being freely disposable in a second direction;

7 a first motor for providing a movement of the stage with the sensor along the first
8 direction of the at least one first guide rail; and
9 a second motor for providing a movement of the stage with the sensor along the
10 second direction of the at least one second guide rail.

1 9. The apparatus according to claim 1, wherein the source of radiation emits
2 acoustic high-frequency waves.

1 10. A method of identifying a semiconductor device, comprising:
2 a) moving the source of radiation and the sensor to a first position above a
3 identification pattern matrix of holes or elevations;
4 b) irradiating a beam of radiation onto a first spot on the surface using the source
5 of radiation;
6 c) detecting the radiation, which is reflected from the spot on the surface using the
7 sensor;
8 d) determining the first distance of the surface spot to the sensor using a means
9 for determining the distance;
10 e) repeating steps a), b), c) and d) for determining at least a second distance of at
11 least a second surface spot to the sensor having at least a second position;
12 f) generating a three-dimensional image of surface height from the at least first
13 and second distance as a function of the at least first and second position; and
14 g) using a pattern recognition algorithm to identify the identification
15 pattern matrix of holes or elevations.

1 11. The method according to claim 10, further comprising:
2 applying a threshold value to the three-dimensional image before using the pattern
3 recognition algorithm for associating a binary value with each of the at least two positions
4 on the surface.

1 12. The method according to claim 10, further comprising scanning a portion
2 of the semiconductor device surface including the identification pattern with the source of
3 radiation and the sensor for obtaining a three-dimensional image of the surface portion,
4 the spots having a pitch between 20 μm and 50 μm .

1 13. The method according to claim 12, wherein the rate of scanning the portion
2 with adjacent spots is more than 20 khz and less than 40 khz.

1 14. The apparatus according to claim 1, wherein the image processing unit
2 includes a pattern recognition device for identifying the identification pattern.

1 15. A semiconductor device identification apparatus for reading an
2 identification pattern from the surface of a semiconductor device, the identification
3 pattern including a matrix of holes or elevations formed in the surface, comprising:
4 a source of radiation for irradiating the holes or elevations;
5 a sensor for detecting the radiation being reflected from the surface and the holes
6 or elevations;

7 a measurer for determining the distance of the sensor to the semiconductor device
8 surface;
9 at least one motor for moving the sensor in at least one distance level above the
10 surface;
11 a control unit for controlling the movement due to the at least one motor; and
12 an image processing unit, the image processing unit being designed to generate a
13 three-dimensional image of the surface with the matrix of the holes or elevations, the
14 image processing unit being connected to
15 a) the measurer for determining the distance for acquiring distance data,
16 and
17 b) the control unit for acquiring positional data of the sensor.

1 16. The apparatus according to claim 15, wherein the radiation has a spot
2 diameter of less than the diameter of the holes or elevations.

1 17. The apparatus according to claim 16, wherein the source of radiation is a
2 laser.

1 18. The apparatus according to claim 15, wherein the sensor is a position
2 sensitive device receiving reflected light by a beam divider.

1 19. The apparatus according to claim 15, wherein the image processing unit
2 includes a pattern recognition means for identifying the identification pattern.

1 20. The apparatus according to claim 19, wherein the image processing unit
2 includes a pattern recognition device for identifying the identification pattern.

1 21. The apparatus according to claim 15, wherein the matrix of holes or
2 elevations represents a bar code on the semiconductor device.

1 22. The apparatus according to claim 16, wherein the laser spot diameter
2 ranges from 4 μm to 20 μm , the vertical measurement range of the laser is 300 μm , the
3 vertical height of at least one of the holes or elevations is more than 80 μm , the diameter
4 of at least one of the holes or elevations (is more than 80 μm .

1 23. The apparatus according to claim 15, further comprising:
2 a stage carrying the sensor;
3 at least one first guide rail, at which the stage is mounted being freely disposable
4 in a first direction;
5 at least one second guide rail, at which the first at least one guide rail is mounted
6 being freely disposable in a second direction;
7 a first motor for providing a movement of the stage with the sensor along the first
8 direction of the at least one first guide rail; and
9 a second motor for providing a movement of the stage with the sensor along the
10 second direction of the at least one second guide rail.

1 24. The apparatus according to claim 15, wherein the source of radiation emits
2 acoustic high-frequency waves.

1 25. A method of identifying a semiconductor device, comprising:

2 b) moving the source of radiation and the sensor to a first position above a
3 identification pattern matrix of holes or elevations;

4 b) irradiating a beam of radiation onto a first spot on the surface using the source
5 of radiation;

6 c) detecting the radiation, which is reflected from the spot on the surface using the
7 sensor;

8 d) determining the first distance of the surface spot to the sensor using a
9 measurer for determining the distance;

10 e) repeating steps a), b), c) and d) for determining at least a second distance of at
11 least a second surface spot to the sensor having at least a second position;

12 f) generating a three-dimensional image of surface height from the at least first
13 and second distance as a function of the at least first and second position; and

14 g) using a pattern recognition algorithm to identify the identification
15 pattern matrix of holes or elevations.

1 26. The method according to claim 25, further comprising:

2 applying a threshold value to the three-dimensional image before using the pattern
3 recognition algorithm for associating a binary value with each of the at least two positions
4 on the surface.

1 27. The method according to claim 25, further comprising scanning a portion
2 of the semiconductor device surface including the identification pattern with the source of
3 radiation and the sensor for obtaining a three-dimensional image of the surface portion,
4 the spots having a pitch between 20 μm and 50 μm .

1 28. The method according to claim 27, wherein the rate of scanning the portion
2 with adjacent spots is more than 20 khz and less than 40 khz.